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logically compels a rejection not only of imitation, but of perception itself.

W. P. MONTAGUE.

COLUMBIA UNIVERSITY.

AN EXPERIMENTAL STUDY FOR CLASSES IN REASONING AND ITS TRANSFERENCE

FAIRLY ample provisions for experimental approach to the notions of sensations, perceptions, imagery, and even attention already exist, thanks to the experimental psychologist who, from the nature of his science, made these largely analytic conceptions his first concern. The teachers of the science feel the need for enlarging these earlier "tramping-grounds" so as to include such notions as concepts, judgments, recognition, reasoning, and so on, and to place them on an experimental basis. The need of better methods of approach to the explanation and control of the thought processes is self evident from the fact that they constitute the direct and essential mental activities involved in learning, in industrial processes, in social intercourse, and in industrial organization. In this connection it is encouraging to observe that a more than substantial beginning in experimentation on the thought processes has been in progress for the last decade. These experimental contributions have been supplemented by critiques, summaries, and a few extended treatises, all of which should enrich our teaching programme.

Some years ago Spindler[1] rendered timely service to those members of the psychological fraternity who have to teach the fundamental notions of the science to beginners by giving a description of the general attitude he adopted and the methods employed in teaching the concept to his classes. I had hoped that the pen of Professor Spindler or that of some other would furnish a similar description of methods of procedure in presenting working notions of other higher thought processes to elementary classes. My continued hope or wish in the matter is father to the account here submitted for presenting the notion of reasoning by means of experimentation.

Neither apology nor justification for an extended use of experimentation in teaching the laws of mental life seems any longer in order. Reference is made to the matter simply to emphasize the desirability of allowing the means by which psychology has become a science to be used in turn as a method in teaching it.

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[1] Spindler, F. N.: "Some Thoughts on the Concept," this JOURNAL, Vol. V., page 684.

For clearness and brevity in presentation I have adopted the form in common usage for reporting experimental work with comments here and there.

Problem.—To observe the elements of the reasoning consciousness, their modification under practise, and the transference of the latter.

Material.—Two series of questions asking for dates. Series A consists of two sets I., II., of ten questions each. Series B consists of 200 questions divided into 20 sets of 10 each. A stop-watch. If a higher degree of accuracy and control is desired, the experimenter and subject may work in separate rooms communicating by means of a pair of telephones and measure the time in answering the questions with a Hipp chronoscope provided with a mouth reactor.

SERIES A, SET I

1. If Wednesday is January 28, what will be the date of the next Monday?
2. If Monday is May 3, what was the date of the previous Thursday?
3. If Thursday is September 28, what will be the date of the next Wednesday?
4. If Tuesday is October 3, what was the date of the previous Thursday?
5. If Sunday is August 30, what will be the date of the next Thursday?
6. If Saturday is June 3, what was the date of the previous Sunday?
7. If Friday is July 30, what will be the date of the next Wednesday?
8. If Wednesday is February 3, what was the date of the previous Saturday?
9. If Monday is March 26, what will be the date of the next Sunday?
10. If Thursday is April 1, what was the date of the previous Saturday?

Set II. of Series A is similar to set I., save that the names of the days of the week, of the month, and the dates occur in a different order, *e. g.*, the first given date will be odd and the second even, the third odd and the fourth even, and so on.

SERIES B, SET I

1. If Monday is the 13th, what was the date of the previous Tuesday?
2. If Friday is the 10th, what will be the date of the next Wednesday?

3. If Monday is the 19th, what was the date of the previous Friday?
4. If Friday is the 20th, what will be the date of the next Thursday?
5. If Tuesday is the 27th, what was the date of the previous Thursday?
6. If Tuesday is the 18th, what will be the date of the next Saturday?
7. If Saturday is the 19th, what was the date of the previous Sunday?
8. If Monday is the 12th. what will be the date of the next Saturday?
9. If Tuesday is the 21st, what was the date of the previous Sunday?
10. If Saturday is the 24th, what will be the date of the next Friday?

The remaining 19 sets of Series B are to be prepared by the experimenter according to the plan given below.

Observe that both Series A and B have some features in common. First, the date asked for is either a past (—) or a future one (+). These dates alternate throughout both series. Second, the numbers of days between the given date and the required vary uniformly and are repeated in a regular recurring series of three. Such as 4, 3, 5 or 5, 4, 6 and so on. Of course the subject at first is ignorant both of the numbers and of their order, and, owing to the change of the names of the days with each question, the full discovery of the order comes tardily, if at all. In the test series A the required date is always either in the month preceding or in the month following the given date. In the practise series the two dates are within the same month. The given date that requires a + date is an even-numbered date for the first ten questions, while those that require a — date occur on odd numbers, and in the second ten the odd numbers go with the + dates and the even with the — dates. These two sets of conditions alternate with every set of ten questions in the interest of uniformity and control, and to test their possible effects on the time relations.

Procedure.—The test series A, set I., are given to two groups of subjects (C) control and (P) practise, respectively. The more general nature of the questions and the manner of asking them should first be explained, together with an example of each of the + and — dates. The experimenter should maintain uniformity of manner and of voice and adhere strictly to the same phraseology in putting the questions. The stop-watch is started simultaneously with the pronunciation of the *day* whose date is required and stopped when the subject answers with the number of the required date. (In the test series, however, the answer includes both *month* and *date.*) The first set of Series B should be given to the practise group immediately after performing the first set of Series A, and the remaining 19 sets at the rate of one per day until finished. At the end of the 20th set both groups of subjects are given set II. of Series A. Introspections are made after each answer. Those at the beginning of each new series, especially, are characterized by completeness.

Results.—Arranging and tabulating the results (objective) and checking them by the arithmetical methods in common use offer no serious difficulties to the beginner. The time in answering past and future dates is tabulated in separate columns under the respective signs — and +.[2] The following is a typical record of the mean averages of — and + time for answers to 10 sets of Series B.

No. of trial.	1	2	3	4	5	6	7	8	9	10
Mean	+ 4.60	4.04	3.40	2.52	3.38	2.56	1.86	2.34	2.84	2.52
Averages	— 6.00	5.14	4.10	3.64	3.50	3.22	2.34	2.60	3.60	3.30

The initial and final records of the same series and subjects are: + 4.8 and + 1.5; — 8.0 and — 3.5 seconds, respectively. The records of the test series taken before and after the practise series for the same subject are: before + 9.76 and — 10.90 and after + 5.12 and — 6.76 seconds, giving an average of 42.30 per cent. of transfer.

Among the observable facts of bodily behavior are: (1) tapping with the fingers on the table, chair arm, subject's body, etc.; (2) resting and covering the face with the hands; (3) "screwing up" the facial muscles, especially about the eyes; (4) closing the eyes and grasping the arm or the seat of the chair; (5) repeating portions of the question half audibly, *e. g.*, the given date. The subjects report a stiffening of the body as the question is put, and a slight, but decided movement of the whole body to the front or back, right or left, according as the answer is given as a — or + date. The writer experiences an incipient movement to the right of the whole body in thinking of a future date and to the left of past dates. One of my subjects refers a future date to the left. I have noticed occasionally a slight toss of both head and hand of this subject to the left when giving a future date and to the right when the given date was past. Both observation and introspection make it possible to trace the history of these extraneous movements as affected by the practise in answering the questions.

Two graphs are drawn, one showing progress in making answers to questions of — dates and the second to questions of + dates.

The introspections are studied and the more significant portions are ranged in a time order for comparison with graphs and tables. The introspections furnish ample opportunity for the study of

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[2] I hope to make a full report later of experimental results now being secured from trained psychologists and scientists acting as subjects.

"time forms" as it may appear in imagining the days of the week. One subject finds a "hump" or hillock at Sunday-Monday which he reports as interfering when these two days appear within the time interval.

My subjects so far develop their methods gradually rather than suddenly "in a happy moment." One method finally settled upon is to determine the intervening number of days by always counting forward; in the case of a + date, the count is forward from the given date to the required date, the number thus determined is added; in the case of — dates, the count is forward from the required date to the given one, the number of the count is then subtracted from the given date. Another method developed more slowly, but used eventually with equal rapidity consists in counting forward from the *required* date to the day ending the week of the given date in the case of + dates; the number of the count is deducted from 7 and the remainder added to the given date, *e. g.*, If Tuesday is the 19th, what is the next Saturday? The subject counts: Sunday, Monday, Tuesday, and thinks 3. Then $7 - 3 = 4$, but $4 + 19 = 23$. Therefore, Saturday is the 23d. For determining a — date the count is forward from the *given* date to the day ending the week from the required date, the number of the count is deducted from 7 and the remainder subtracted from the given date. In determining either — or + dates this subject used the day ending the heptad as the first objective point, and began the count either from the required or the given date, depending on the conditions of the question. After settling upon a method, the subjects soon begin to determine dates of the 6-day interval with marked rapidity; with such an interval the date often seemed *given* with the question and the intervening steps are omitted. Just as the old habit of recognizing dates of 7 days or a week interval formed an objective point from which the date of a 6-day interval is readily determined, so the new habit of apprehending dates of a 6-day interval gradually favored in turn the determination of a 5-day interval. Thus dates of 5- and 6-day intervals are determined with far greater rapidity than those of 4 days!

Discussion and Summary.—(The following questions are merely suggestive and justified in part by the brief results given above; they direct attention to significant portions of the results, encourage further experimentation, and urge a more critical reading of the literature[3] on the part of the student.)

If it be granted that the aspects of reasoning involve (*a*) apprehending a problem, (*b*) devising a method, (*c*) applying the method to the problem, and (*d*) an attitude toward the solution as belief, doubt, testing, may the answers to both the test and practise series be accepted as the results of reasoning? The introspections, especially the earlier ones, are studied for purposes of identifying any one or all of these aspects, to ascertain which are more evident and constant, and to identify those that grow less noticeable with practise. What old habits, bodily and mental, were serviceable in devising your method and in applying it? Make a list of the mental and bodily habits formed during the practise series and indicate which ones facilitated or inhibited making answers to the questions in set II., Series A. Was the method that you used gradually developed or did you hit upon it at once? Indicate the kind of questions that were most difficult in Series B; compare these questions with their time records and describe the difficulty in detail. Indicate the dominant type of imagery and the more persistent forms of movement. Is there any appreciable and constant difference in the time required to determine a past date when the given date is an odd number from that when the latter date is an even number? Compare the time required to determine a future date, when the given date is even, with that required to determine a past date, when the given date is odd. (My results thus far do not show a constant difference for all subjects.) Do these several considerations and the recorded results indicate that reasoning processes are subject to modification with practise? State the nature and the direction of the modifications.

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[3] Pillsbury, W. B., "The Psychology of Reasoning," 1910; Titchener, E. B., "Experimental Psychology of the Thought Processes," 1909, or Binet, Alfred, "The Psychology of Reasoning," 1907.

Further experimentation is quite possible with these "time reckoning problems" under slight variations in the form of the question and in the time interval, uniformity of control being still maintained. For example, if Wednesday is the 16th, what *day* of the week is the 19th? Or, if Wednesday is the 16th, what day of the week was the 11th? Or again, upon what date *will* an 8 months' note mature that was made March 15th? Or, upon what date *was* an 8 months' note made that matured November 15th? These conditions produce four types of problems: When the time interval is limited to weeks the problems are (1) a date and an interval given, to find a date; (2) given a day and two dates, to find the other day. When the time interval is limited to months the problems are (3) a date and an interval given, to find a month and date; (4) given two dates and a month, to find the other month.

LINIUS W. KLINE.

STATE NORMAL SCHOOL,
DULUTH, MINN.